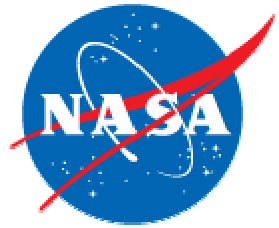
National Aeronautics and Space Administration



Validation of the Aura Microwave Limb Sounder ClO Measurements

Michelle Santee + MLS Team
Jet Propulsion Laboratory, California Institute of Technology

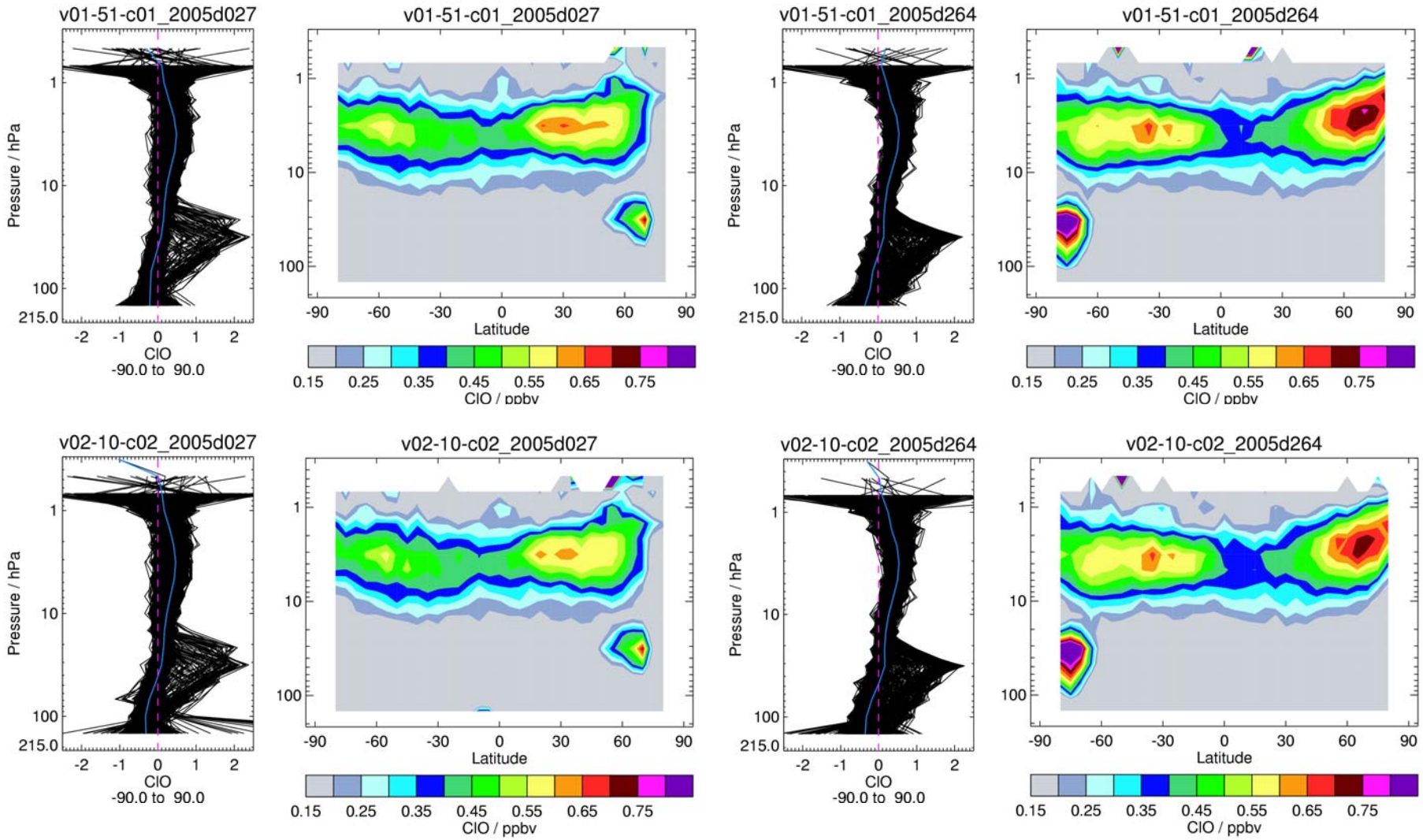
MkIV, SLS Teams
Odin/SMR Team

Aura Science and Validation Team Meeting
11–15 September 2006
Boulder, CO

Overview of Aura MLS version 2.1 (v2.1) ClO Data

- As in v1.5, the standard product for ClO is taken from the 640 GHz retrieval
- v2.1 ClO data are scientifically useful over the range 100 to 1 hPa
- ClO measurements are reported at 6 pressure levels per decade change in pressure
- Vertical resolution is ~3 km from 100 to 10 hPa, ~5 km at 1 hPa
- Adjacent profiles are separated by ~165 km along the orbit track
- Horizontal resolution is ~250 km along-track, ~3 km cross-track
- Brief review of the quality of the version 1.5 (v1.5) MLS ClO data:
  - ⑦ Useful range: 100 – 1 hPa
  - ⑦ Estimated precision: ~0.1–0.2 ppbv throughout the vertical range
  - ⑦ Artifacts: pervasive negative bias of 0.2–0.3 ppbv in both daytime and nighttime mixing ratios below ~32 hPa; largely eliminated by taking Day-Night differences

Comparisons between v2.1 and v1.5 MLS ClO Data

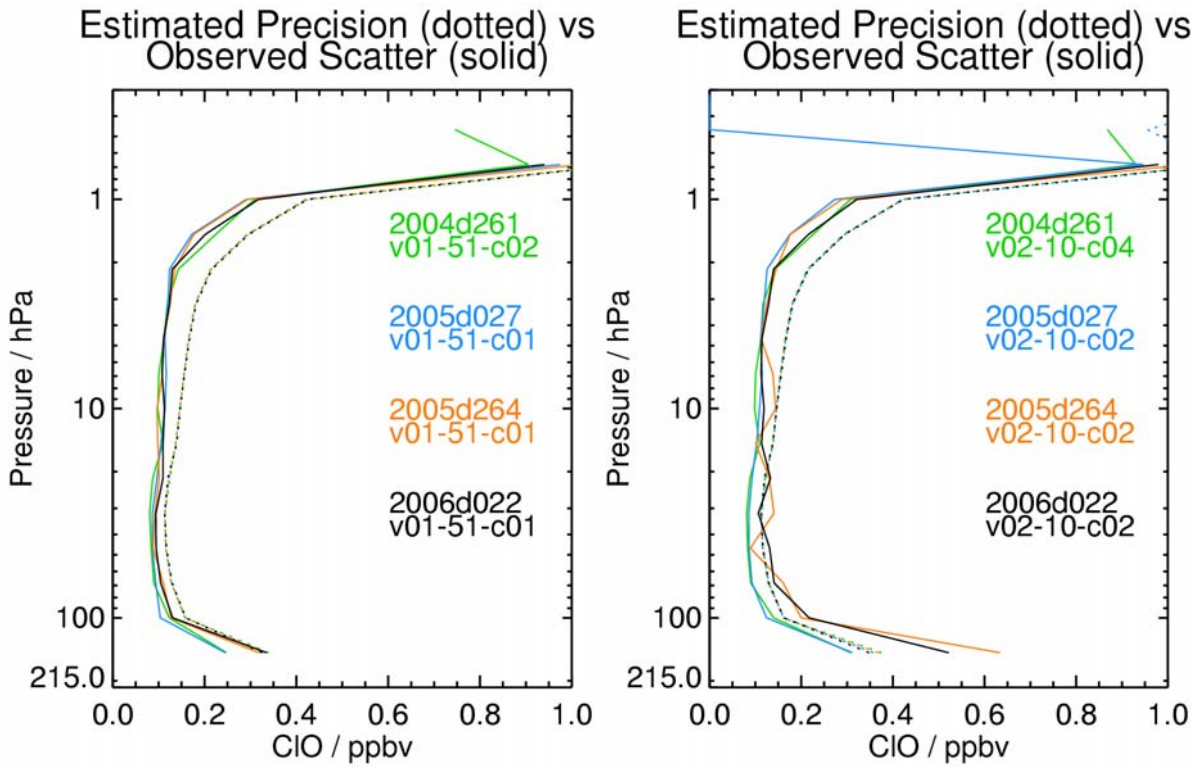


- v2.1 vs. v1.5: Profiles are slightly noisier, max values at the secondary peak are smaller, and the negative bias at lowest levels is slightly larger

Precision of Aura MLS v2.1 ClO Data

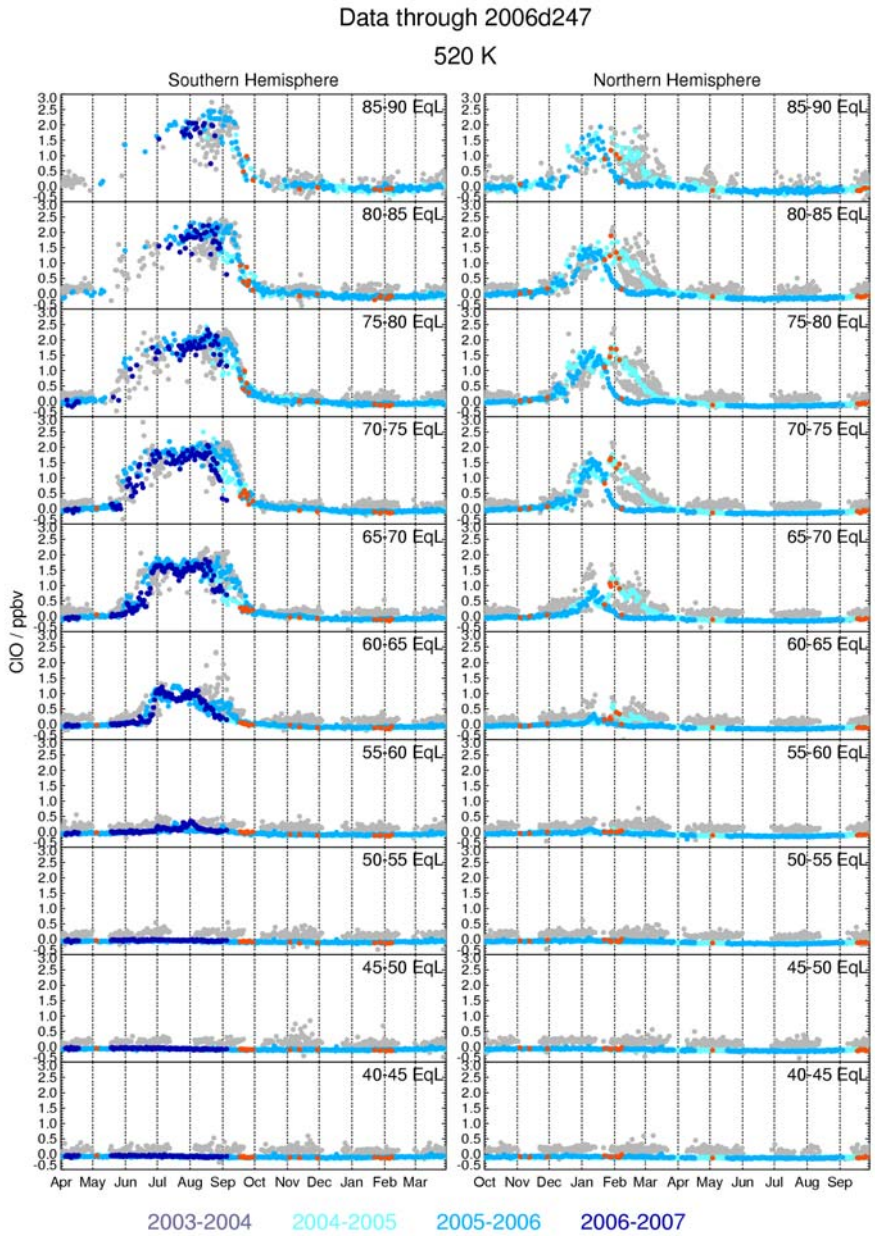
- Scatter in the v2.1 data in a 20°-wide band centered around the equator (where atmospheric variability should be small) indicates ClO precision of ~0.1–0.2 ppbv throughout most of the vertical range
- Observed scatter in the v2.1 ClO data is slightly larger than it was in v1.5, especially at the lowest retrieval levels

- The single-profile precision reported by the Level 2 software agrees well with the observed scatter in the lower stratosphere but overestimates it slightly above 10 hPa

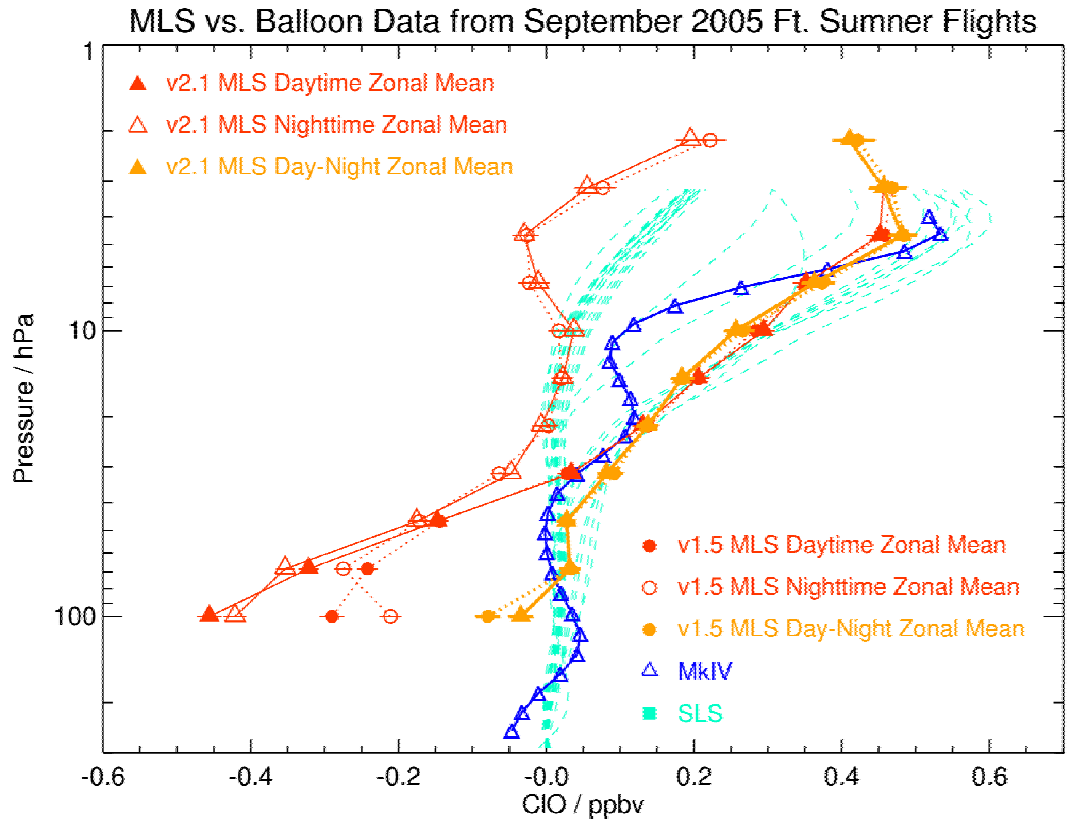


Comparison with UARS MLS ClO Climatology & v1.5

- Time series of MLS ClO at 520 K (~46 hPa, 19 km) for both the Southern (left) and Northern (right) Hemispheres
- Grey dots: daily means from UARS MLS for 1991–2000
- Blue dots: daily means from v1.5 Aura MLS for 2004–2006
- Red dots: daily means from v2.1 Aura MLS (17 available days, 2004–2006)
- The evolution of ClO over an annual cycle, and the latitudinal distribution of enhanced wintertime ClO, generally matches that of UARS MLS very well
- The low bias in Aura MLS ClO data is evident



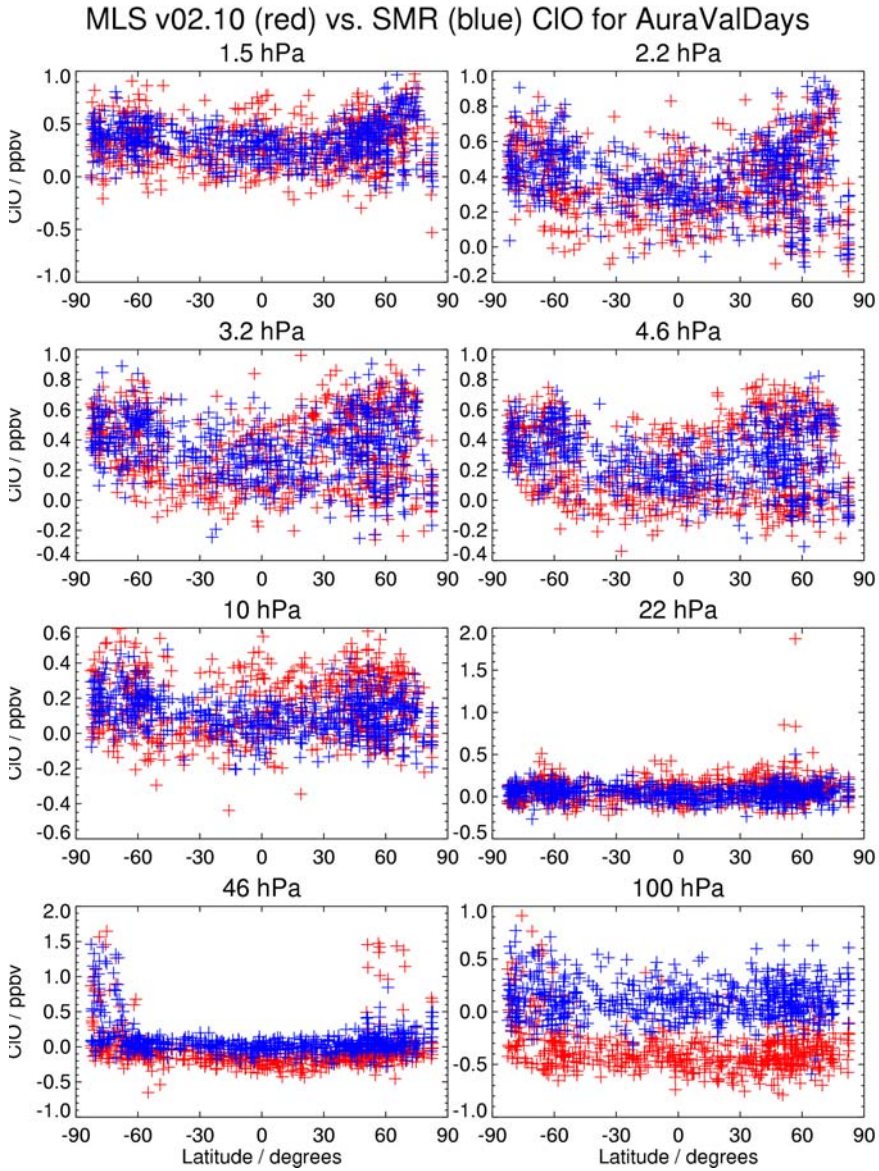
Comparisons with Balloon ClO Data



- Comparisons with balloon measurements made near Aura overpasses in September 2005 show a significant negative bias in v1.5 MLS ClO mixing ratios below ~32 hPa that is even larger (~0.4–0.5 ppbv) in v2.1
- Taking Day-Night differences largely eliminates the low bias in MLS ClO

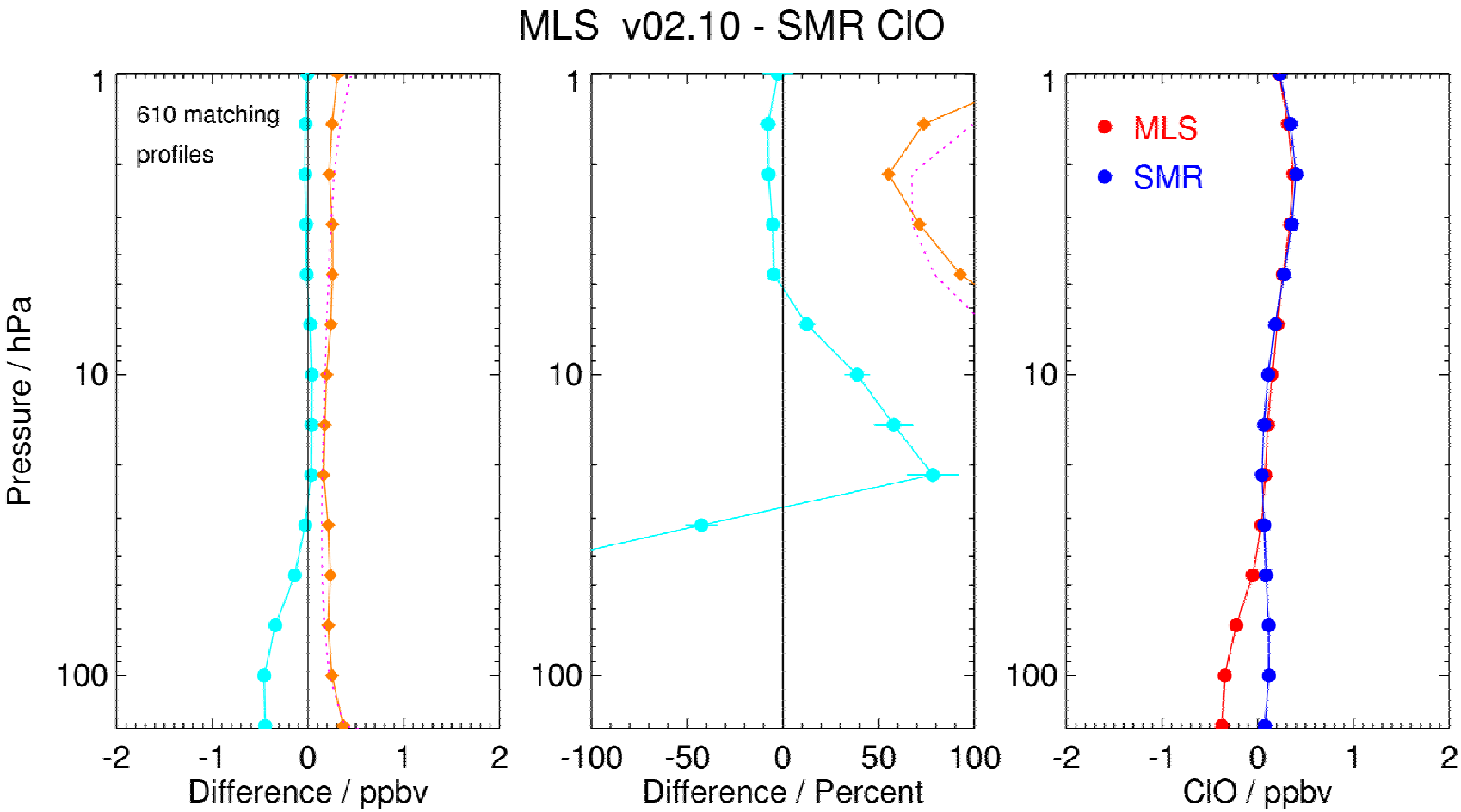
Comparisons with Odin/SMR ClO Data

- "Chalmers v2.0" SMR data
- All coincident profiles from MLS and SMR for 17 days
- Coincidence criteria: ±1° latitude, ±4° longitude, ±12 hours
- No solar zenith angle (SZA) criteria have been imposed for these comparisons, which may affect agreement for some points
- Agreement in general morphology is excellent
- Compared to SMR, MLS v2.1 ClO is considerably smaller at the lowest retrieval levels, where MLS has a known negative bias



Comparisons with Odin/SMR ClO Data

- Average differences between MLS v2.1 and SMR ClO are small (less than 0.1 ppbv) except at the lowest levels, where they rise to 0.5 ppbv



Circles = mean difference, Diamonds = rms difference, Dotted = expected rms

Summary of v2.1 MLS ClO Data Quality

- v2.1 MLS ClO measurements are similar to those in v1.5
  - Profiles are noisier and have slightly larger oscillations, and the low bias below ~32 hPa has been exacerbated
  - Useful range: 100 to 1 hPa
  - Vertical resolution: ~3 km from 100 to 10 hPa, ~5 km at 1 hPa
  - Estimated precision: ~0.1–0.2 ppbv throughout the vertical range
  - Artifacts: pervasive negative bias of 0.4–0.5 ppbv in both daytime and nighttime mixing ratios below ~32 hPa; largely eliminated by taking Day-Night differences
- Significant changes are not expected for ClO in version 2.2